

**TechNet '97  
Sea Services Day Breakfast**

**VADM Arthur K. Cebrowski  
CNO-N6  
18 June 1997**

*“There is nothing more difficult to take in hand, more  
perilous to conduct, or more uncertain in its success  
than to take the lead in the introduction of a new order  
of things.”*

*Niccolo Machiavelli, The Prince*

# **Network Centric Warfare: A Revolution in Military Affairs**

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**“... it’s a fundamental shift from what we call platform-centric warfare to something we call network-centric warfare.”**

**Admiral Jay L. Johnson, USN  
Chief of Naval Operations**



# What is a Revolution?

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**“A fundamental change ...”**

- in thinking**
- in visualizing**
- in preference**

**“A displacement of the conceptual network ...”**

**“Non-cumulative developmental episodes ...”**

**“A change of paradigm ... ”**

# Previous Scientific Revolutions

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## *Astronomy*

### *Copernican Revolution*

- Ptolemaic (Geocentric)  - Copernican (Heliocentric)


## *Physics*

### *Newtonian Revolution*

- Galilean Dynamics  - Newtonian Dynamics

## *Physics*

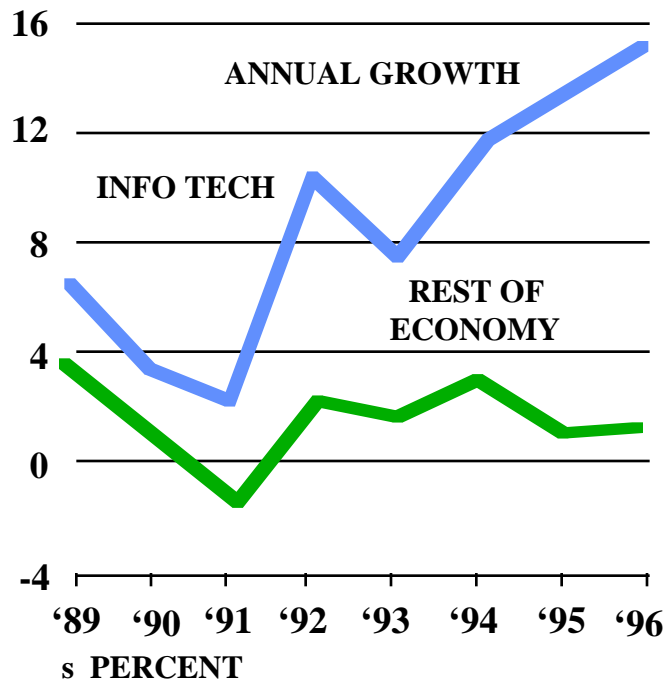
### *Modern Physics*

- Newtonian Dynamics  - Relativistic Dynamics  
- Quantum Mechanics

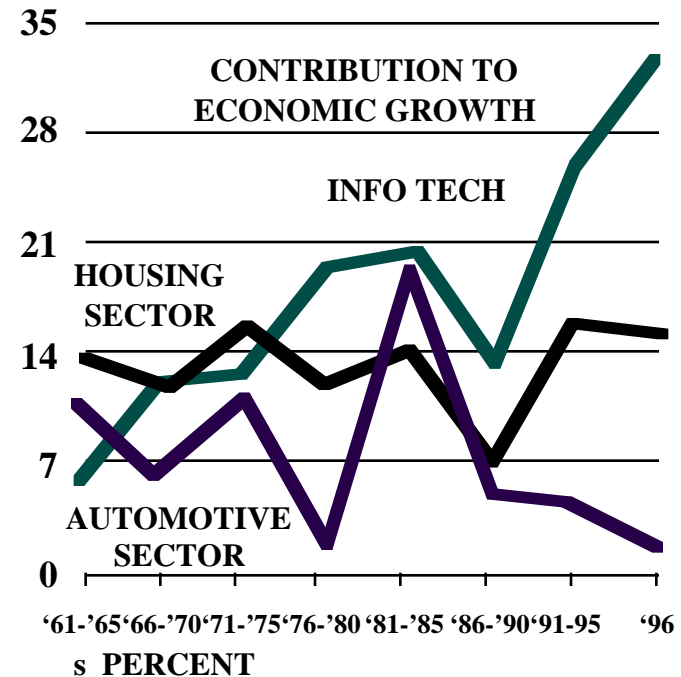


# The New Business Cycle

## The Information Technology Sector Is Accelerating ...



## ... Dominating The Expansion ...



**Implication: Information Technology is new engine of economic growth**

Source: Business Week / March 31, 1997



# The Changing Dynamics of Competition


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## *Coevolving Ecosystems*


### *Information Technology*

- Platform Centric
- 
- Network Centric

### *Business*

- Company Centric
- 
- Network Centric
  - Increasing Returns vs. Decreasing Returns

### *Warfare*

- Platform Centric
- 
- Network Centric
  - Speed of Command
- Attrition

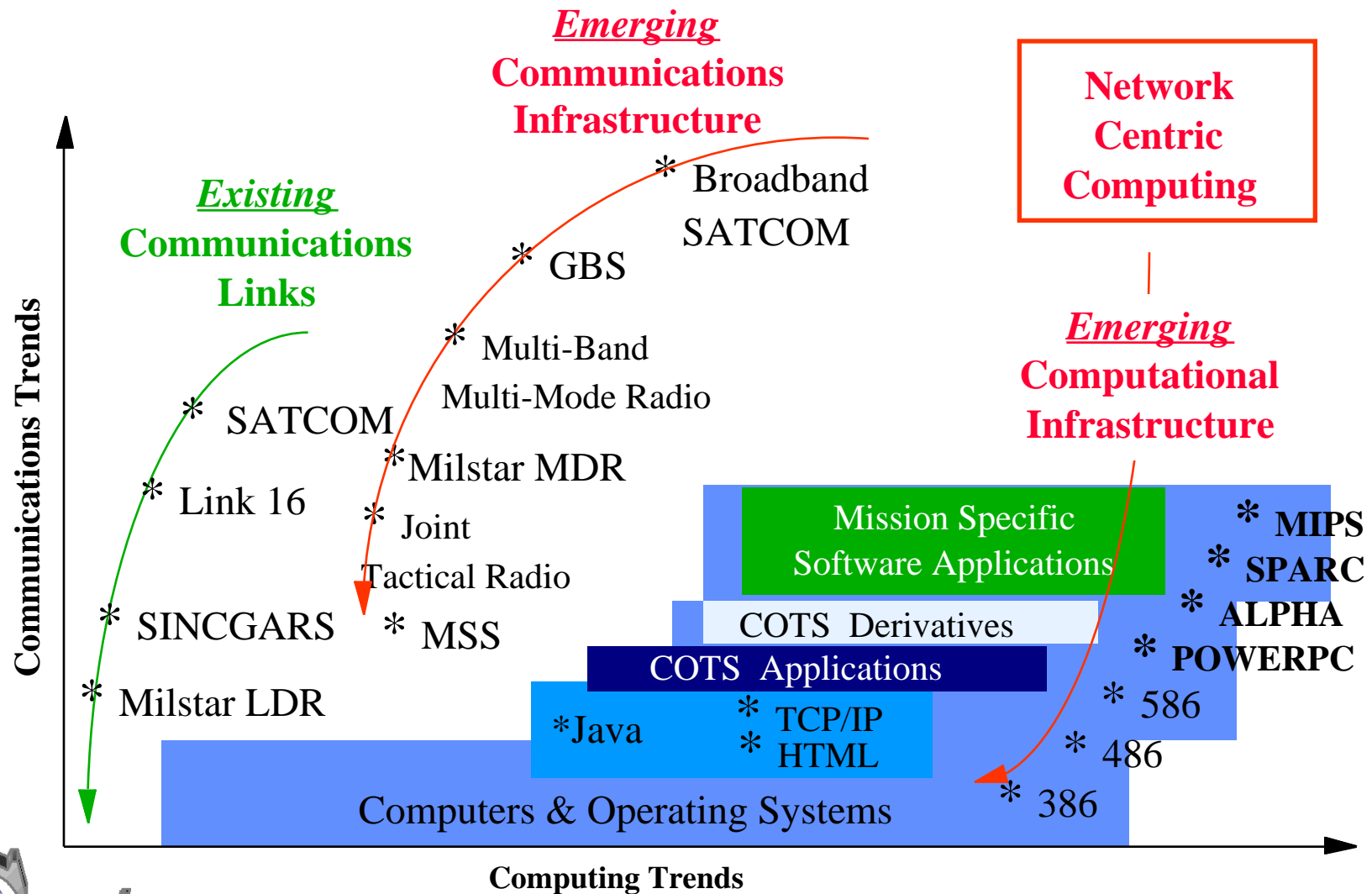


# Coevolving Information Ecosystems

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- **Corporate Strategies**
  - **Sun Microsystems**
    - » **“The Network is the Computer”**
  - **IBM**
    - » **Old Focus: Platform Centric (“Big Iron”)**
    - » **New Focus: “Network Centric Computing”**

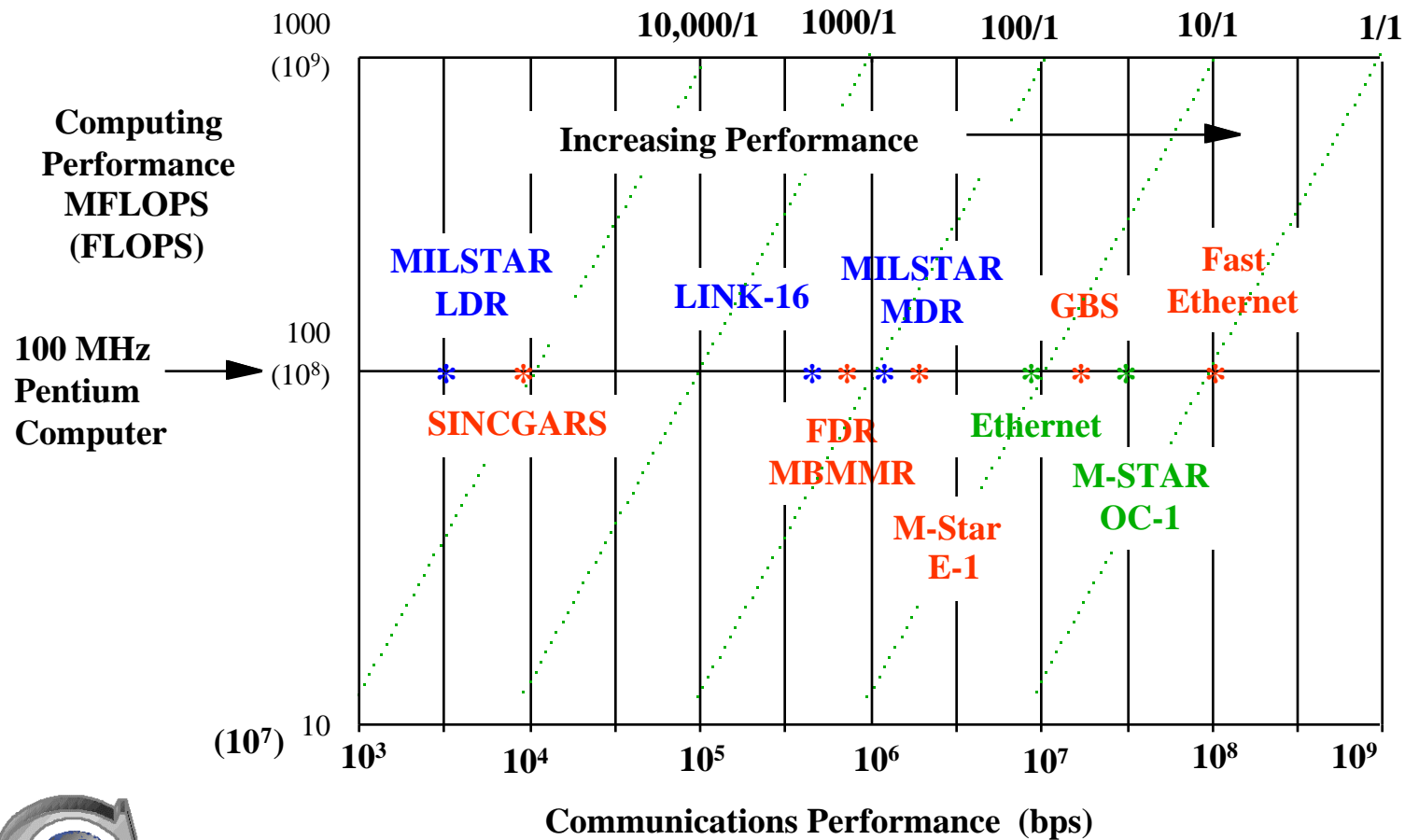
# Information Technology Enables Network Centric Computing





# Network Centric Computing

Ratios for Network Centric Computing (MFLOPS/Mbps)  
Computing (MFLOPS)/Computing (Mbps)



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# Increasing Returns vs. Decreasing Returns

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- **Decreasing Returns**

- (Economy A)

- **Absence of Mechanisms for Product Lock-in**
      - » **Competing products are Interchangeable**
    - **Market share equilibrium**
      - » **Increased costs to achieve greater market share**
    - **Examples:**
      - » **Consumer Non-Durables**
        - **Food**
      - » **Consumer Durables**
        - **Automobiles**

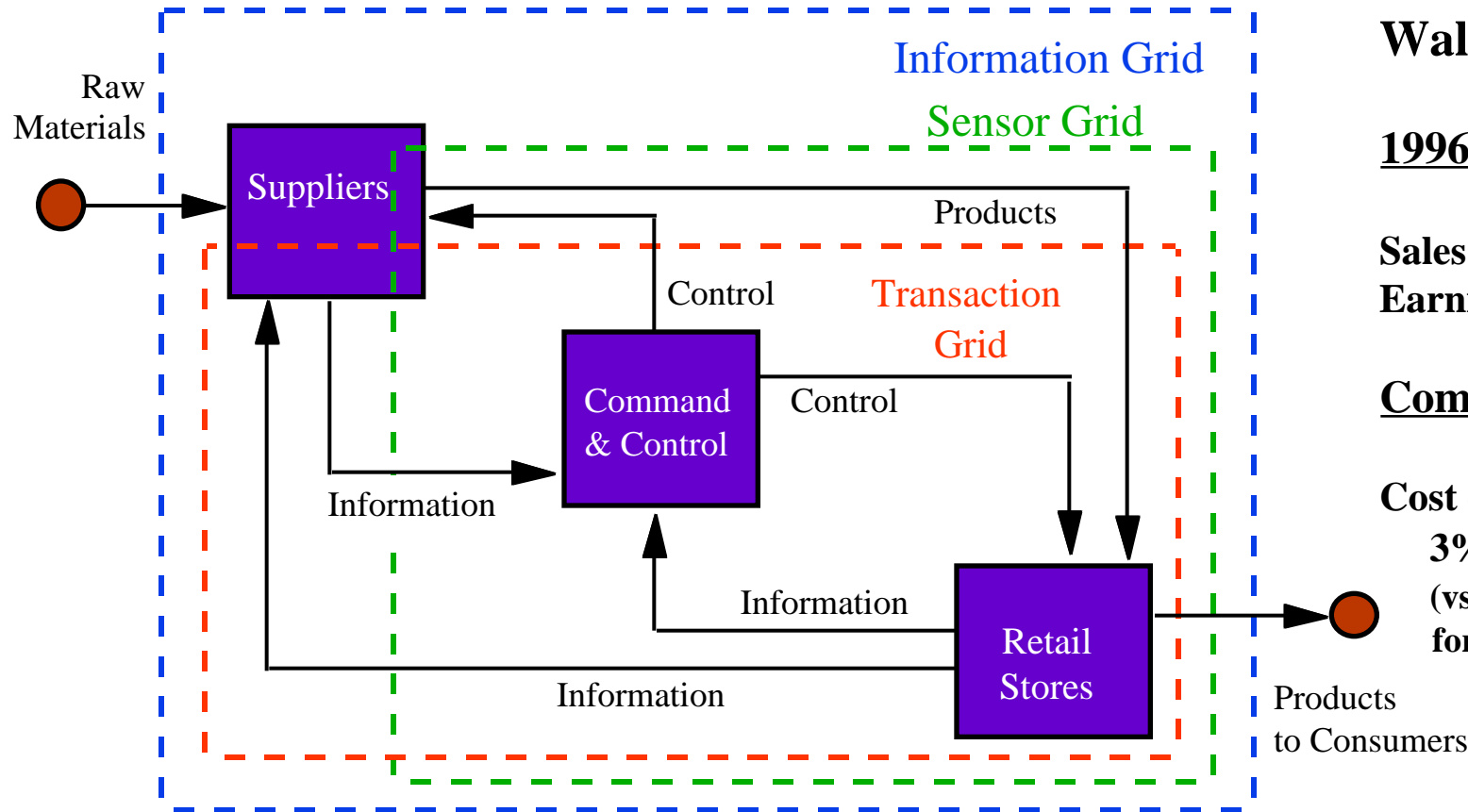
- **Increasing Returns**

- (Economy B)

- **Mechanisms for Product Lock-in**
      - » **Competing products are not interoperable**
      - » **Network Effects**
      - » **User skills**
    - **Examples:**
      - » **Standards**
        - **VHS vs. Beta**
        - **MAC vs. DOS/Windows**
      - » **Skill Set**
        - **“QWERTY” Typewriter**
        - **Ethernet vs. ATM**



# Network Centric Retailing



## Wal-Mart

### 1996 Results<sup>1</sup>

**Sales: \$104.9 Billion**  
**Earnings: \$3.056 Billion**

### Competitive Edge<sup>2</sup>

**Cost of Distribution**  
**3% of Sales**  
**(vs. 4.5 to 5% for Competition)**

“Competitive Space” Awareness is a key Competitive Advantage in the Retail Sector

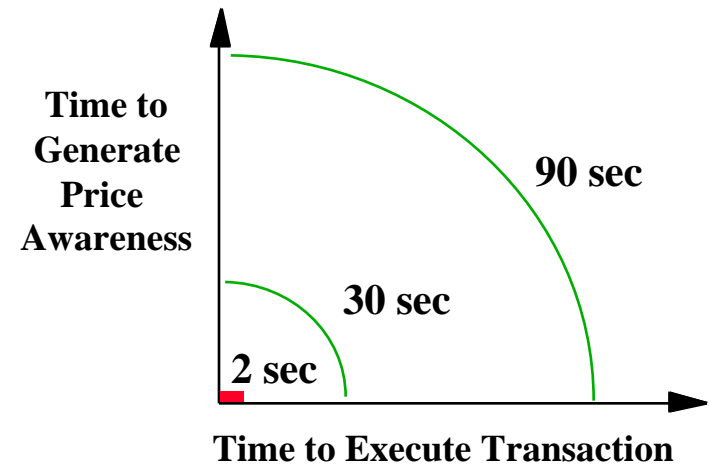


Source: 1. Investors Business Daily, 1997  
2. *The Death of Competition*, 1996

# Competitive Space: Bond Trading

- Competition between Securities Trading Ecosystems

- Deutsche Morgan Grenfell Inc. vs. Goldman Sachs vs. Merrill Lynch vs. Cantor Fitzgerald, etc.
- Competition Based on Time
- Business Model
  - Maximize Profit for Trading Firm
    - Increase number and profitability of transactions
  - Maximize Value to Customer
    - Price
    - Selection
    - **Service = Transaction Time**



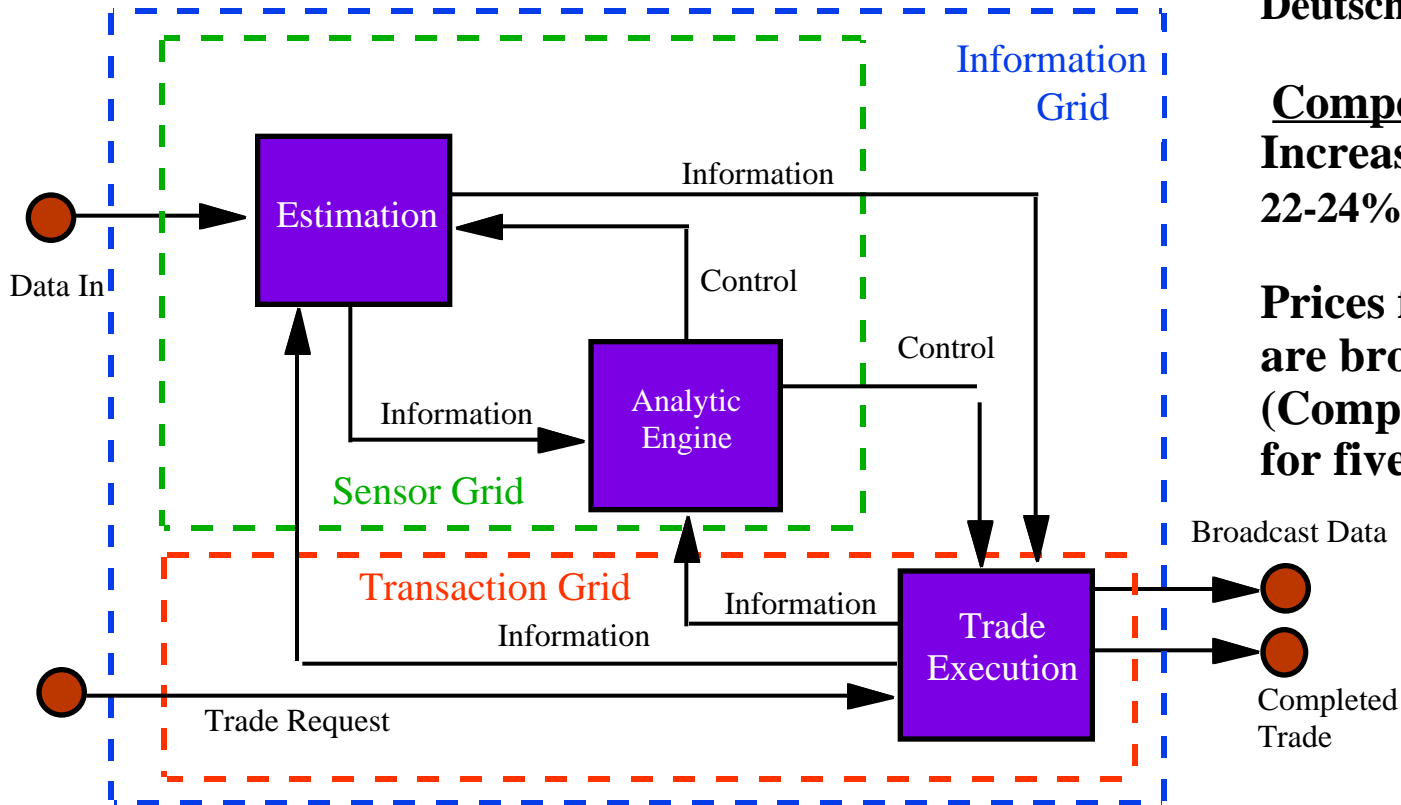
- **DMG** - within 2 seconds 95% of the time
- **Competition**
  - 30 sec to 90 sec
  - 30 sec: 10% of the time



Source: Interview with Christopher J. Carroll, Managing Director, Global Electronic Trading, DMG

# Network Centric Bond Trading

*“The Network is the Market<sup>SM</sup>”*



**Company:**

**Deutsche Morgan Grenfell Inc.**

**Competitive Edge**

**Increased Trading Volume -  
22-24% per Month**

**Prices for 210 to 230 bonds  
are broadcasted continuously  
(Competitors provide data  
for five benchmarks)**

**“Competitive Space” Awareness is DMG’s Competitive Advantage in Securities Trading**



Source: Interview with Christopher J. Carroll, Managing Director,  
Global Electronic Trading, DMG

# Coevolving Business Ecosystems

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- **Source of Competitive Edge**
  - Information grids enable network centric computing
  - Sensor grids create awareness of competitive space
  - Transaction grids exploit awareness to provide a competitive edge
- **Emergence of new modes of competition**
  - Competition between Business Ecosystems
    - » Enabled by coevolving information ecosystems
    - » Competition based on time
  - Competition characterized by Increasing Returns
    - » Implications for Warfare



# The Changing Dynamics of Competition


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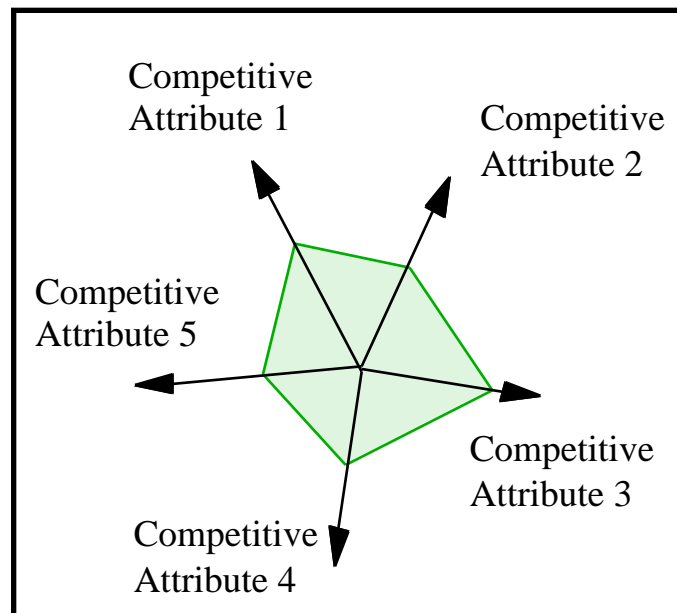
- Platform Centric
- 
- Network Centric
  - Speed of Command





# Strategy vs. Operational Effectiveness<sup>1</sup>

## Strategy



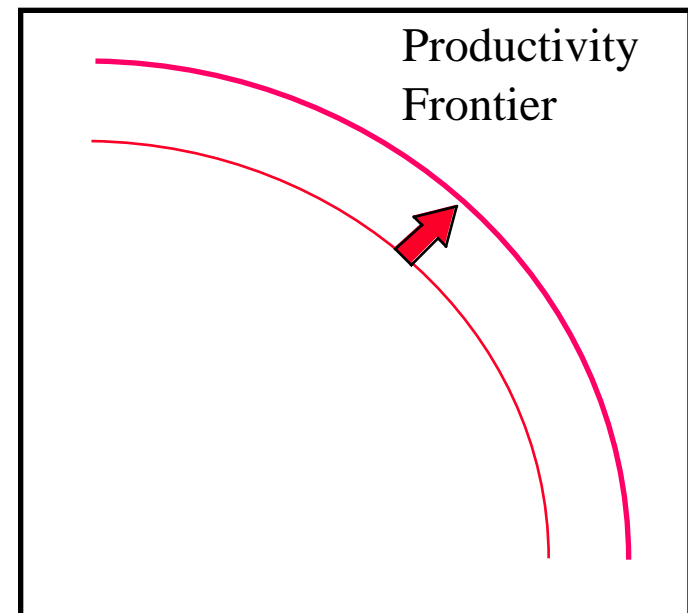
## Competitive Space Selection

## Operational Effectiveness<sup>1</sup>

Nonprice value delivered to customer

high value

low value



high cost

## Relative Cost Position

low cost

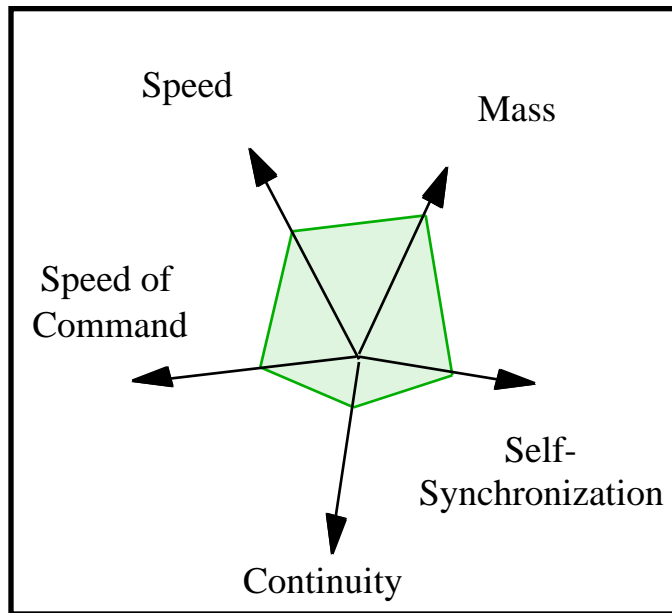


1. Source: "What is Strategy?," *Harvard Business Review*, (November-December 1996)

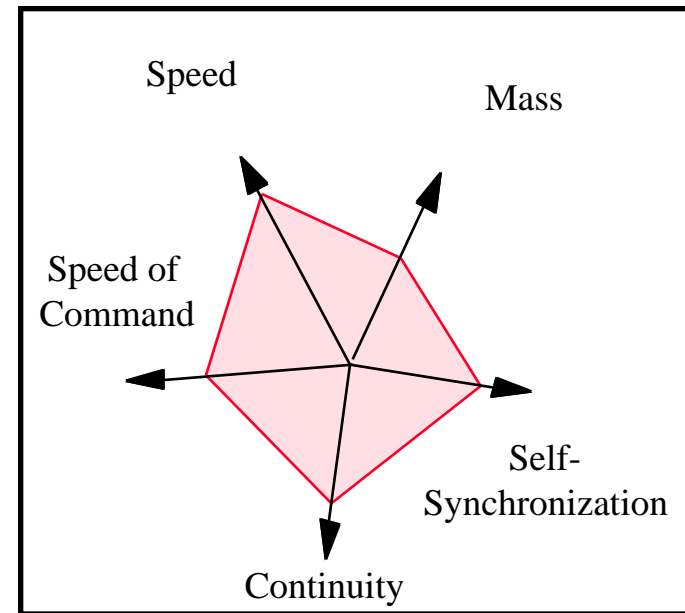
# Strategy

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## Football



## Soccer

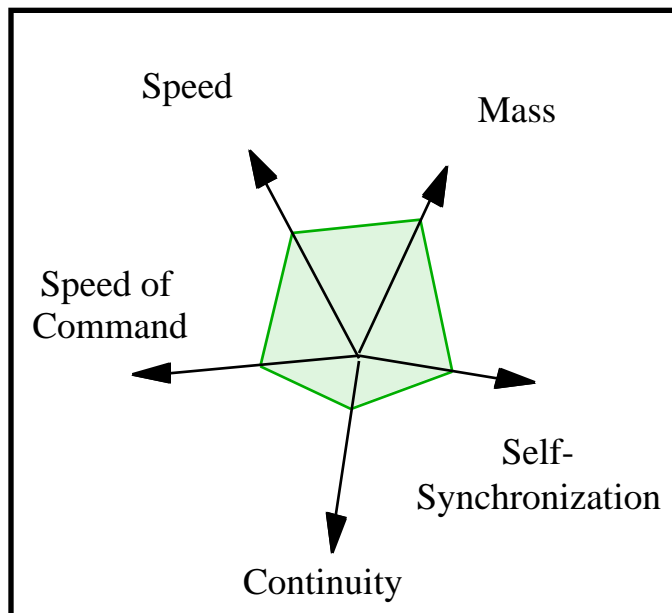


Strategy is About Selecting a Competitive Space

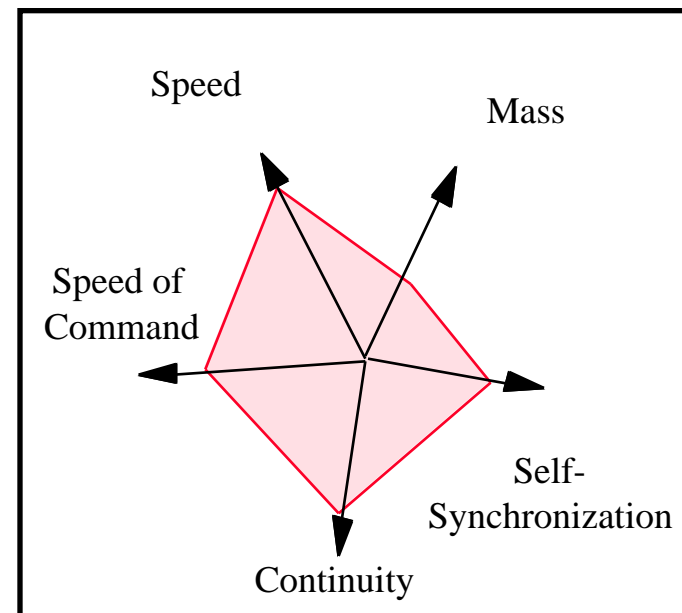
# Strategy

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## Platform Centric Warfare

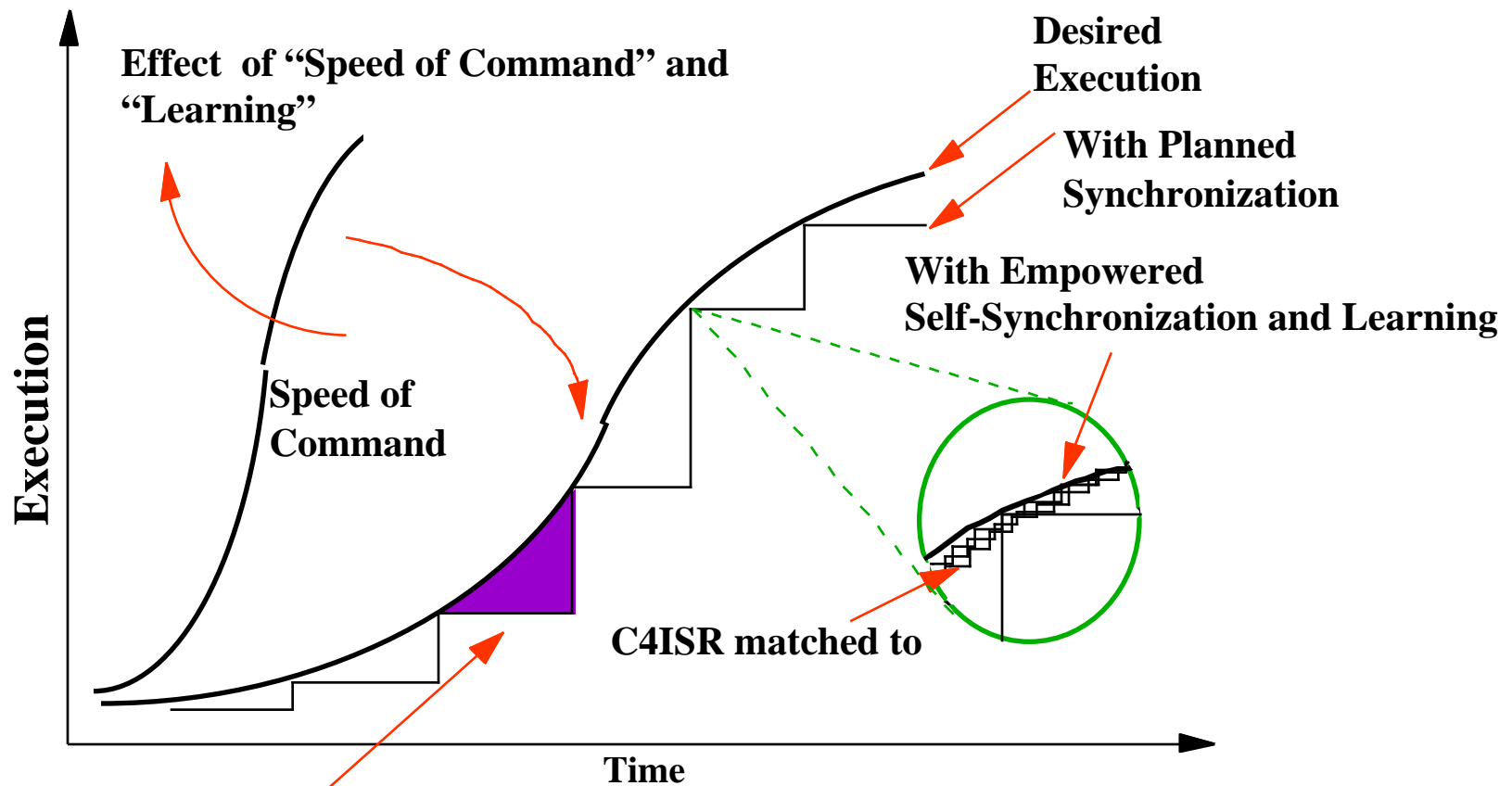


## Network Centric Warfare



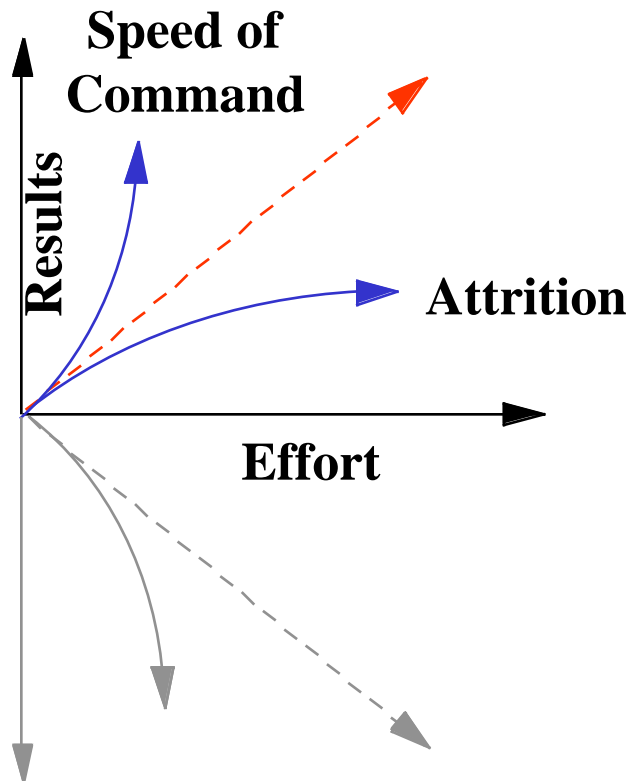
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# Attrition vs. Speed of Command



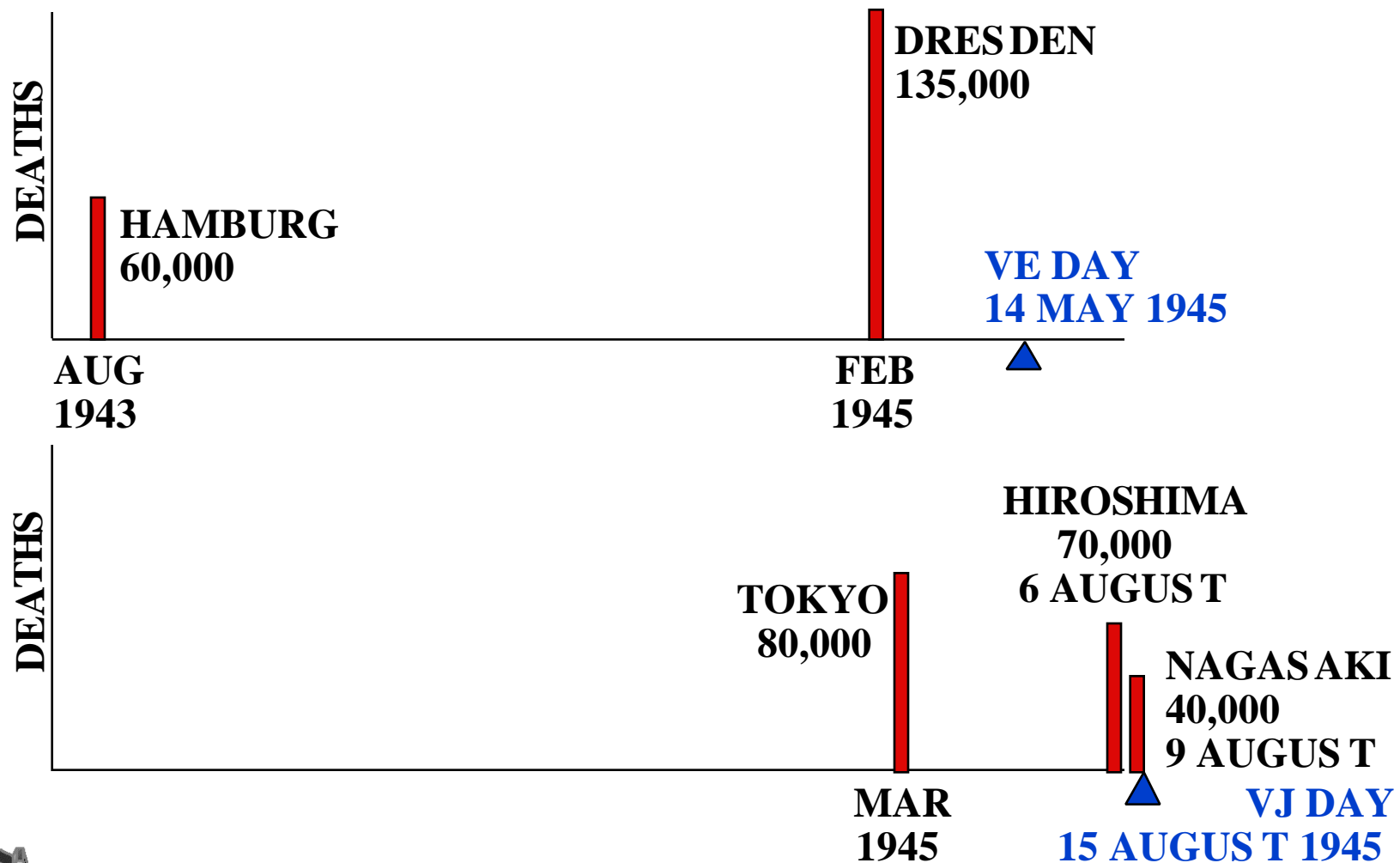
# Attrition vs. Speed of Command

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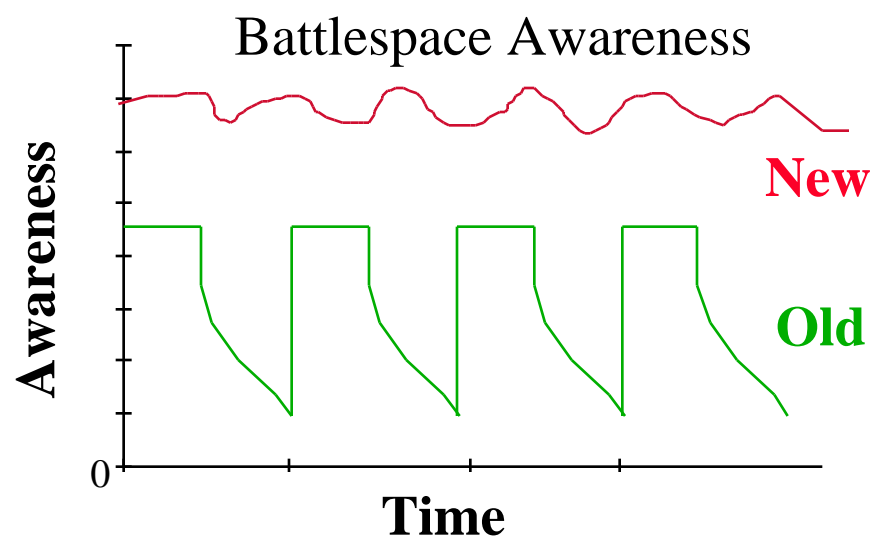
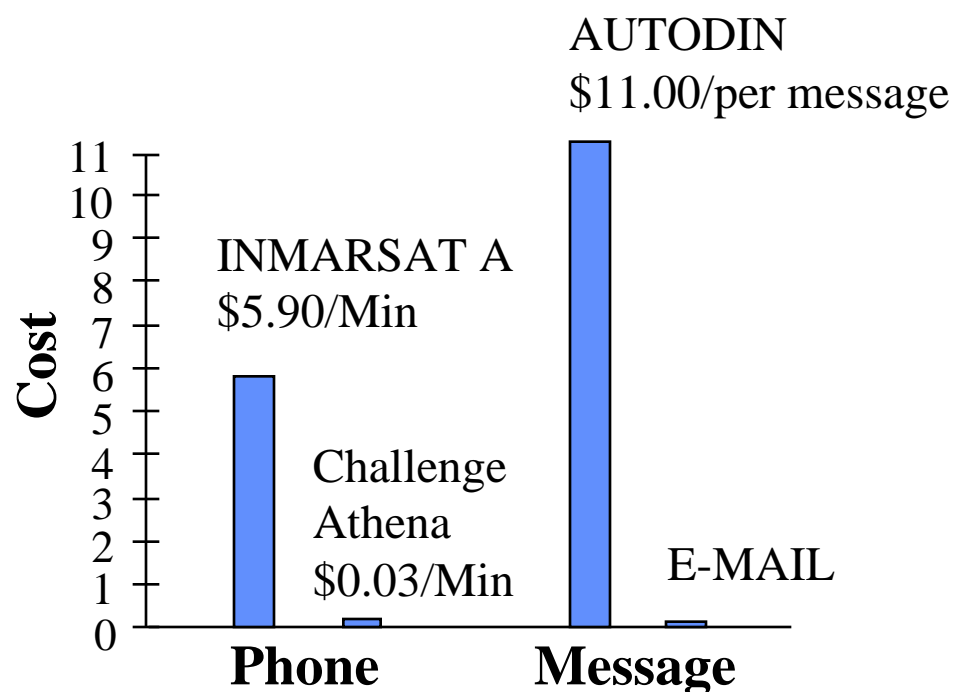
- Methods of achieving “Speed of Command”
  - Overwhelming early effort
  - Learning by gaining knowledge and experience faster (DBA/K & IW)
  - Change initial conditions positively (early effect vs. early effort)
  - Use early victories to offset technology inferiorities
  - Lock out enemy solutions
  - Apply effort on a high speed continuum vice a step function (self- synchronized vs. command synchronized)

# Attrition vs. Speed of Command



Sources: U.S. Strategic Bombing Survey, 1944-1947, and James Stokesbury, A Short History of Air Power, 1986.

# Speed of Command: Taiwan Straits



## Higher Sustained Situational Awareness

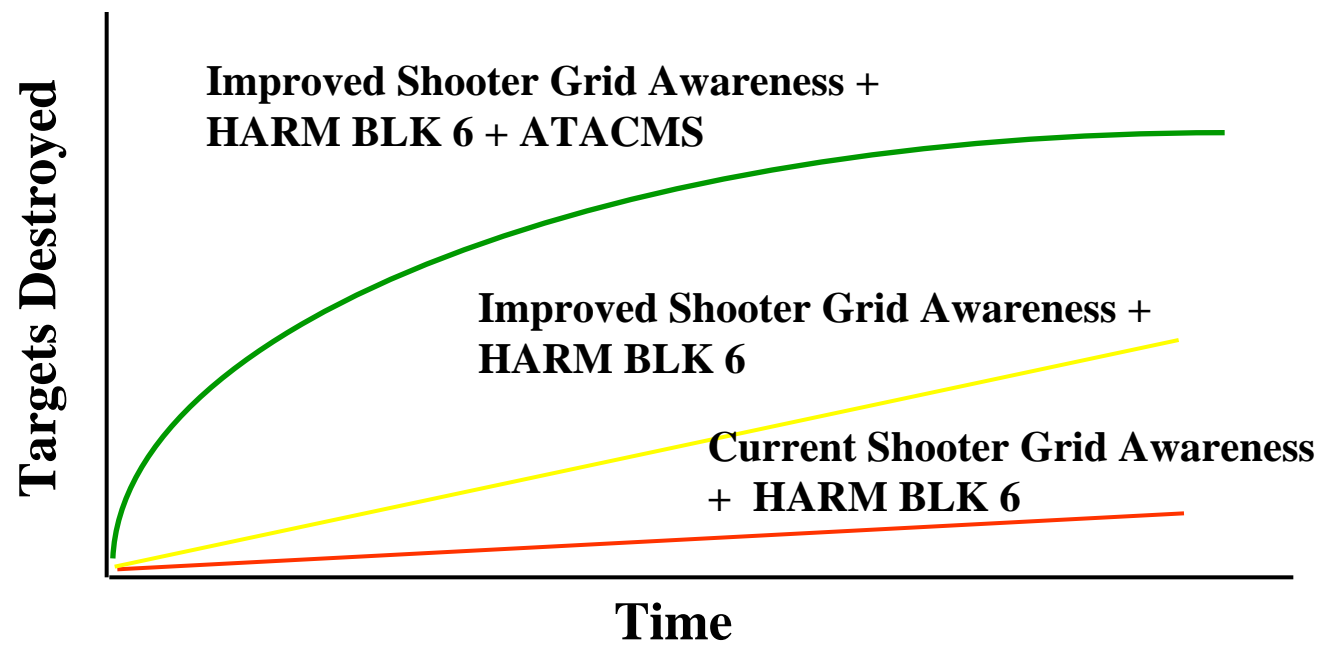
- Enhances Speed of Command
- Lowers Ambiguity
- Reduces Questions
- Enhances Clarity of Mission and Intent



# Network Centric Warfare Increases Joint Combat Power

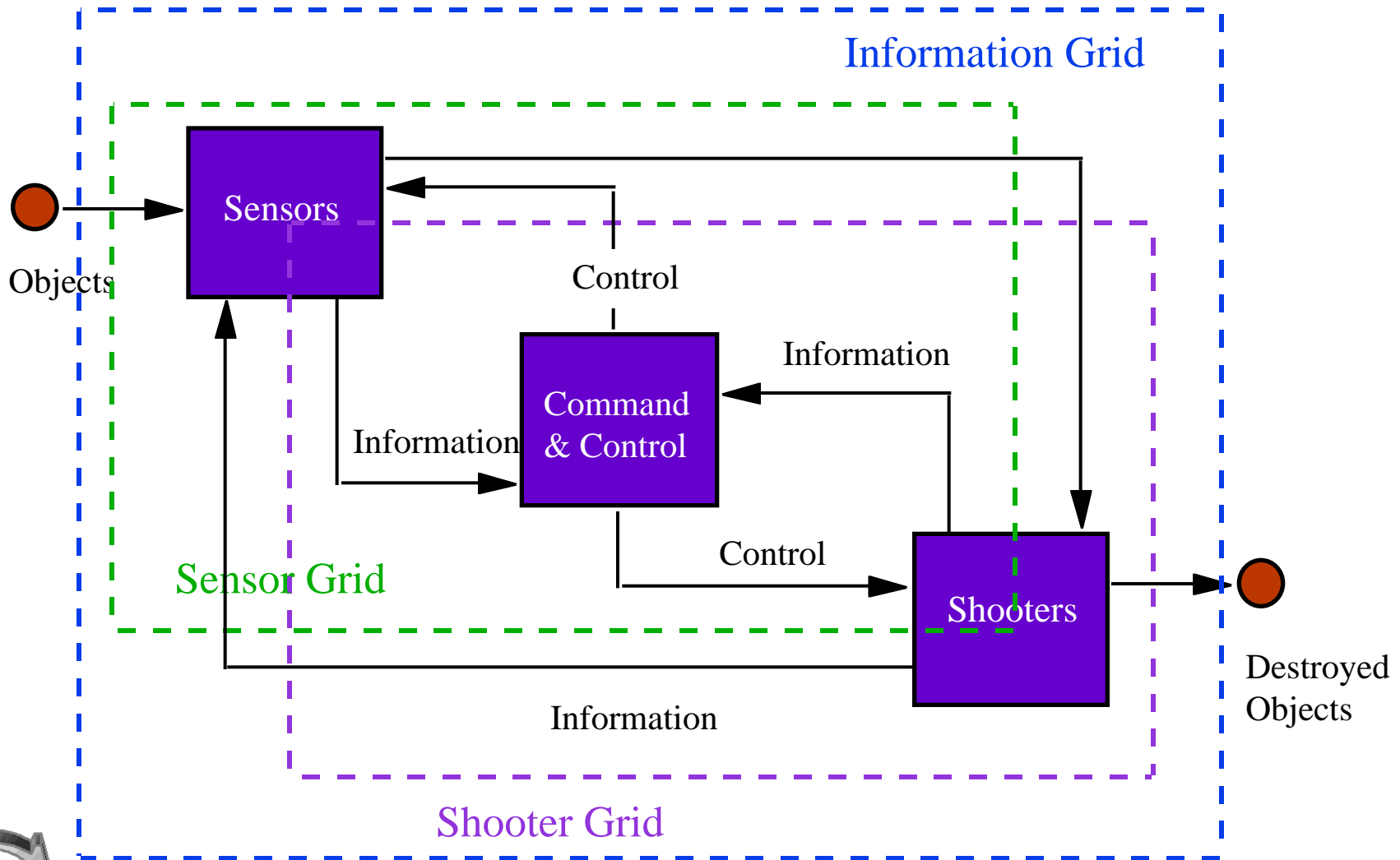
## *Results for Precision Engagement*

- **Operational Impact**
  - Dramatic Early Results
  - Greatest Rates of Change in Initial Phase of a Campaign
  - Inflicts Maximum Losses on the Enemy
  - Shortens Timelines
  - Locks out Enemy Options





# Network Centric Warfare



# Network Centric Warfare

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- Platform Centric Warfare
  - Platforms generate combat power
- Network Centric Warfare
  - Networked platforms generate increased combat power

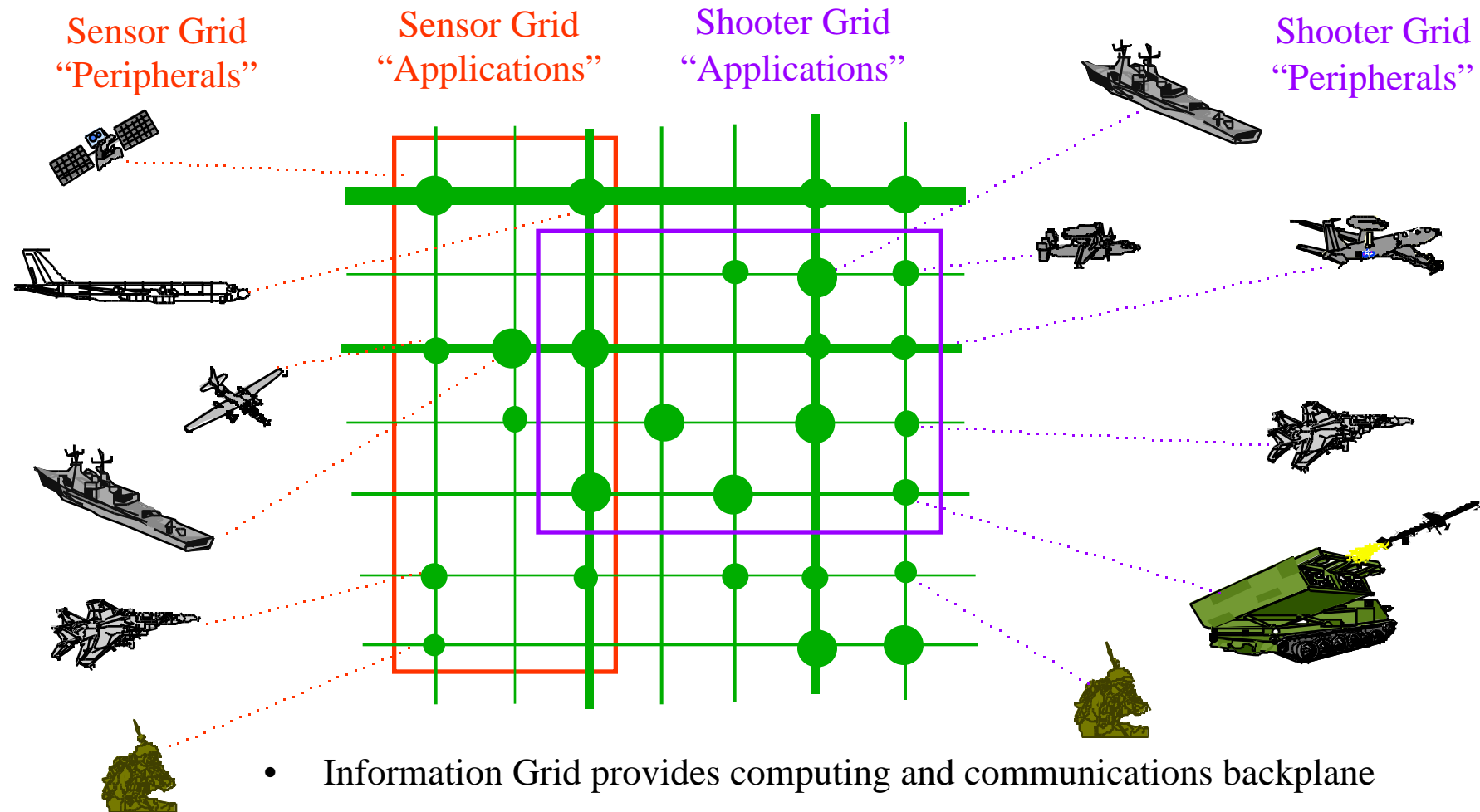
## Metcalfe's Law

“The power (value) of a network increases as the square of the number of nodes in the network ( $N^2$ )”

Robert M. Metcalfe: The Inventor of Ethernet



# Network Centric Warfare



# Network Centric Warfare

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- **Sensor Grids**
  - **Generate Battlespace Awareness**
  - **Synchronize Battlespace Awareness with combat operations**
  - **Increase the Speed of Information**
- **Shooter Grids**
  - **Exploit Battlespace Awareness to generate increased Combat Power**
  - **Enable massing of effects vs. massing of forces**
  - **Maximize Joint Combat Power**
- **Network Centric Warfare**
  - **Changes the dynamics of competition in warfare**
  - **Enables Speed of Command**
  - **Rapidly “Locks Out” Adversary’s Courses of Action**
  - **Provides decisive competitive edge in warfare**



# How Do We Get There?

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# Implications: Intellectual Capital

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**“There is today no real career path for personnel who will manage our critical information warfighting functions. Neither do we have a training program analogous to what we have for an F-18 pilot ... In order to fix this shortfall, we must start an aggressive C<sup>4</sup>ISR personnel development program, sooner rather than later.”**

**Undersecretary of Defense (A & T)  
Dr. Paul Kaminski  
18 OCT 96**



# Changing The Way We Change

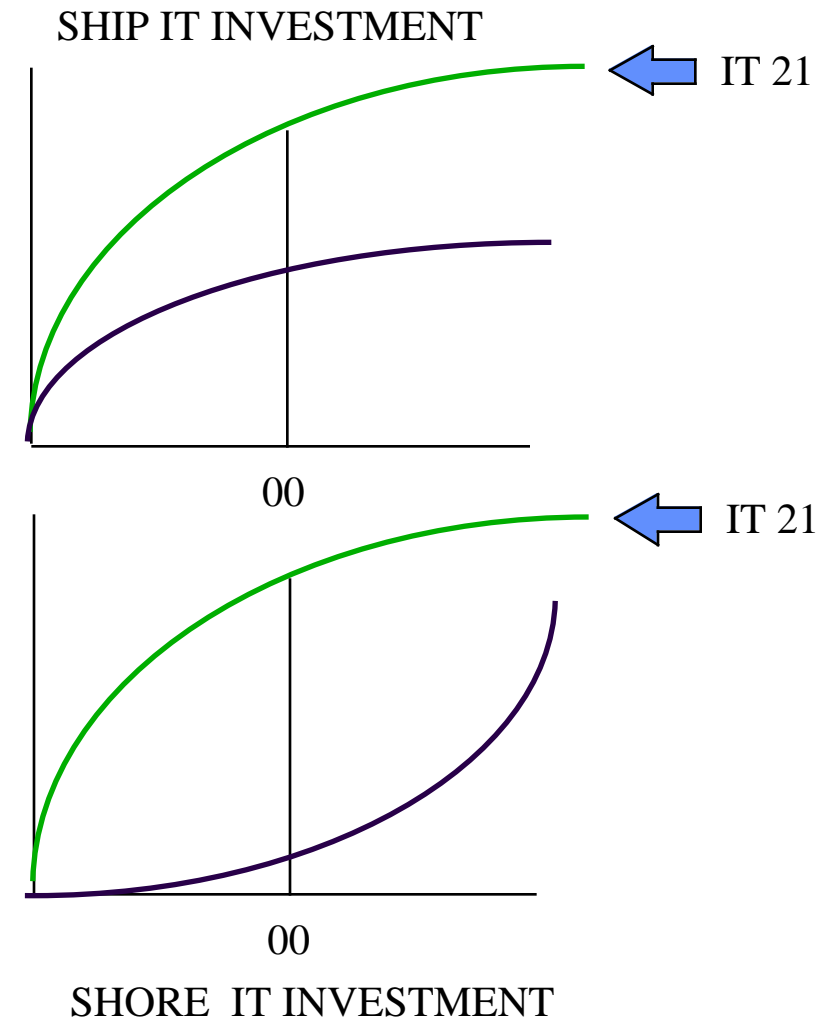
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- **Compelling need for coevolution**
  - **Organization and doctrine are lagging and decoupled from systems progress**
  - **Resistance is systemic and institutionalized**
- **Elements of a potential solution**
  - **Service experiments support Joint experimentation program**
    - » **Fleet Battle Experiments, Sea Dragon, Force XXI**
  - **Maritime Battle Center supports Joint Battle Center**
  - **Enterprise wide technology assimilation**
    - » **CIO provides standards for technical and operational interoperability**
    - » **Exploit technology: ATDs and ACTDs**
  - **Mechanisms for measuring progress**
  - **A climate which encourages innovation throughout the Fleet**



# Implications: Resource Allocation

- **Marginally Smaller**
- **Somewhat Leaner**
- **More Modern**
- **More Combat Capable**





# Naval C4ISR Booth

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- **Connectivity**
  - JMCOMS/Mini-DAMA
  - TV-DTS
- **Sensor-to-Shooter - BGPHERS**
- **Common Tactical Picture - JMCIS → GCCS-M**
- **Information Warfare - Defensive IW**
- **Also ...**
  - Architectures
  - Maritime Battle Center/Fleet Battle Experiments



